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The fungus *Colletotrichum graminicola* causes corn anthracnose, a damaging disease in the U.S. Corn Belt and many other locations in the world where corn is grown. The anthracnose syndrome encompasses fungal attack of most corn tissues throughout the plant's development. Anthracnose leaf blight (ALB) and anthracnose stalk rot (ASR) are of particular concern because of their effects on corn yield. Estimated grain yield losses due to anthracnose range from zero to 40%, depending on hybrid, environment, timing of infection, and other stresses. Anthracnose is a not a new disease, having been documented in North America since 1855. It emerged as a disease of economic consequence in the early 1970s in several north central and eastern U.S. states. Widespread epidemics of the 1970s and early 1980s were variously attributed to new biotypes of the fungus, corn hybrids with increased susceptibility, wet cloudy weather that favored the disease, and changes in cultural practice that increased survival of the fungus and availability of infective spores. There is little doubt that the general increase in anthracnose over the last 25 years is associated with regional increases in infected corn stubble remaining on the soil surface as a consequence of conservation tillage.

Anthracnose is widespread today in U.S. corn production. In general, modern corn hybrids are less susceptible to both ALB and ASR than were prevalent hybrids of 20 years ago. Yet, sporadic epidemics resulting in yield loss still occur when plants are exposed to abundant spores and favorable weather conditions. Yield losses associated with ASR have been particularly common in plants injured by the European corn borer. In the late 1990s, there is an apparent resurgence of anthracnose as a production problem in some areas.

Fungus Survival and Dispersal

Colletotrichum graminicola is a devious enemy. It is an aggressive attacker of living corn plants. But it also persists between crop seasons by extracting nutrients from corn residues on the soil surface. When warm temperatures and moist conditions return in spring, the fungus produces millions of spores on the surface of infected corn residues. These spores are dispersed over fairly short distances to nearby corn seedlings by splashing and blowing raindrops. The spores are produced in a sticky gelatinous material that aids in fungal survival and pathogenic ability. This slime or spore matrix has physical properties that protect the otherwise fragile spores from desiccation and ultraviolet radiation. One component of the slime is a chemical self-inhibitor that prevents spore germination at high concentration in the fungal fruiting structure but allows germination at lower concentration when the spores and inhibitor are diluted and dispersed in films of water on corn leaves. The spore matrix contains several degrading enzymes that enable attack of the corn leaf surface and other components that protect the fungus from defensive chemicals produced by the plant.

Anthracnose Leaf Blight

Spores adhere to the corn surface within minutes, germinate within a few hours, and infect the epidermal cells via specialized invasion structures within 24 hours. Infection is favored by moist and warm (77 – 86 °F) conditions. The invading fungus coexists without damaging its host for a day or so, after which it aggressively invades host tissues, killing cells with an arsenal of excreted enzymes and toxins in advance of fungal colonization. Within a few days, anthracnose lesions appear on the leaves. They are often oval with tan centers and red, brown, or yellow-orange borders. Lesions expand in concentric zones and coalesce to blight large areas of a leaf.

Under moist conditions, masses of spores in orange-colored slime are formed in fruiting structures that are evidenced by small dark specks within mature lesions. Spores formed on seedlings are the first of several potential generations of repeating inoculum that will infect emerging leaves on the same plant and leaves of nearby plants. Epidemics are favored by cloudy overcast conditions, but do not depend on extended periods of rain. Secondary spread of the pathogen occurs to a greater extent within rows than across rows. Crop rotation and localized tillage are effective in reducing the initiation of epidemics. However, where the fungus is prevalent on corn debris, these measures may not be sufficient to control late season anthracnose development. Rapidly expanding leaves tend to develop less anthracnose than do seedling leaves or mature leaves on plants after tassel emergence. Anthracnose severity is increased in plants that are stressed by other pests such as the root lesion nematode.

Anthracnose Stalk Rot

Stalk rot is typically considered a disease of mature corn plants approaching senescence. Premature plant death, decayed basal stalk tissues, and soft, often broken, stalks characterize it. *C. graminicola*, along with *Fusarium* and *Stenocarpella* species, causes stalk rot in corn at late stages of development. Basal stalk internodes may be invaded systemically from root infections initiated by contact of roots with infected corn residue, by fungal growth through senescent stalk rind tissues, or from vascular colonization from infected wounds. Anthracnose stalk rot is often associated with a shiny black discoloration of the rind surface and a dark discoloration of rotted pith tissues. The principal effect of late season stalk rot is to reduce the harvestability of the crop.

Unlike most stalk rot fungi, *C. graminicola* also attacks stems of living plants. Spores of the fungus from blighted leaves land on green stalk rinds and infect them in the same manner that they infect leaves. These infections are often superficial, producing discoloration of the rind but not progressing into the pith until the stalks are senescent. Internal stalk tissues become infected when the fungus enters through wounds that breach the rind. Once the vascular tissues are invaded, the fungus systemically colonizes the whole stem causing disruption of sugar and water transport and reducing the development of grain. Under favorable conditions, systemic colonization of corn stalks by *C. graminicola* results in a vascular wilt known as "top dieback" in which upper leaves and stem internodes above the ear are killed prematurely. Systemic ASR during early grain development can result in significant yield reduction. Stalk boring insects, especially larvae of the European corn borer (ECB), commonly wound corn stalks and allow

fungal ingress. ECB larvae also carry viable fungus externally and in their guts, thus insuring the fungus access to fresh wounds as the larvae continually injure stalk tissues. In experiments in New York under low natural populations of ECB, transgenic Bt corn hybrids developed significantly less ASR than did their corresponding non-Bt, near-isogenic hybrids.

Disease Management

Clearly the practice of conservation tillage, which may increase the incidence of anthracnose and other corn diseases, is here to stay. Where debris-associated diseases such as anthracnose become a problem, crop rotations of more than one year away from corn and/or rotational tillage may need to be employed in individual fields.

Corn anthracnose has been and will continue to be managed primarily by deploying corn hybrids with resistance to ALB and ASR. Note that resistance to these two phases of disease may be inherited independently. Relatively little use has been made of germ plasm sources with major genes for anthracnose resistance. Hybrids with moderate levels of partial resistance have yielded satisfactorily in the presence of the anthracnose fungus. Yet there is considerable range in the level of resistance among commercial hybrids. Seed companies have information on the relative susceptibility of their hybrids to ALB and ASR, but producers need to ask.

There has been no convincing evidence of *C. graminicola* races that overcome specific resistance genes in corn. The strategy of selecting for moderate resistance further reduces the likelihood that specific virulence will be selected in the pathogen population. With pressures to develop many new traits in today's corn hybrids there may be less consistent screening for anthracnose resistance than in the past. The anthracnose pathogen is widely distributed and still poses a potential threat to U.S. corn production, so vigilance in monitoring new inbreds and hybrids for susceptibility is warranted.

The strategy of reducing losses due to ASR by deploying Bt hybrids that reduce corn borer injury is promising. Its utility in the presence of high populations of corn borer is yet to be demonstrated.

Selected References

Bergstrom, G.C., and Nicholson, R. L. 1999. The biology of corn anthracnose. Plant Dis. 83:596-608.

Nicholson, R.L. 1992. *Colletotrichum graminicola* and the anthracnose disease of corn and sorghum. Pages 186-202 in: *Colletotrichum*: Biology, Pathology and Control. J.A. Bailey and M.J. Jeger, eds. CAB International, Wallingford, UK.

White, D.G., Yanney, J., and Natti, T.A. 1979. Anthracnose stalk rot. Proc. Annu. Corn Sorghum Res. Conf. 34:1-15.